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[Specification]

1. Title of Invention

Mask Holder

2. [Claims]

1. A mask holder that is equipped with clamps that have wave-shaped V-shaped grooves that are able to engage with the side surface of a mask dry plate and springs that impart energy to said clamps toward the side surface of said mask dry plate to secure said mask dry plate via the V-shaped grooves of said clamps.

3. [Detailed Explanation of the Invention]

Field of Industrial Utilization

The present invention relates to a mask holder used to hold a photomask in an electron beam exposure apparatus used in the field of semiconductor integrated circuits.

[Prior Art]

In recent years, electron beam exposure apparatuses have come to be widely used in the manufacture of photomasks.

When electron beam exposure apparatuses are used to perform mask pattern writing, a mask dry plate is installed in a jig called a mask holder and sent into the vacuum chamber of the exposure apparatus.

A conventional mask holder will be explained below.

Figs. 5(a) and (b) are a plan view and a cross sectional drawing that show a conventional mask holder. In Figs. 5(a) and (b), a chrome layer 2 is provided on a mask dry plate 1, and a resist layer 3 is coated onto the chrome layer 2 of the mask dry plate 1. Upper surface regulating plates 5 are provided on a holder 4, and rods 6 are provided so that they are able to approach and move away from the upper surface regulating plates 5. In order to secure the mask dry plate 1 to the upper surface regulating plates 5, the rods 6 are pushed up by means of springs 7 to interpose and secure the mask dry plate 1 between the front ends of the rods 6 and the upper surface regulating plates 5. In addition, needles 8 are attached to the upper surface regulating plates 5, and in order to prevent the accumulation of an electric charge on the mask dry plate 1,

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which is a factor in the deterioration of pattern accuracy, these needles 8 are caused to pass through the resist layer 3 and come into contact with the chrome layer 2 to allow the electric charge on the mask dry plate to escape. A mask holder configured in this way secures the mask dry plate 1 by pressing it against the upper surface regulating plates ⁵3 [sic] by means of the pushing up of the rods 6 by the springs 7.

[Problems to Be Solved by the Invention]

In this way, a conventional mask holder performs securing by pressing the mask dry plate 1 against the upper surface regulating plates 5 from below by means of rods 6. However, in the aforementioned conventional mask holder, there were problems in that pattern writing was not possible on portions of the mask dry plate 1 that were hidden by the upper surface regulating plates 5, and the writable area became smaller.

The present invention solves the aforementioned conventional problems and has as its purpose the provision of a mask holder with which pattern writing to nearly the

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entire surface of the mask dry plate is possible, that reliably secures the mask dry plate, and that is able to ensure electrical conduction with the mask dry plate.

[Means to Solve Problems]

In order to solve the aforementioned problems, the mask holder of the present invention is equipped with clamps that have wave-shaped V-shaped grooves that are able to engage with the side surface of a mask dry plate and springs that impart energy to said clamps toward the side surface side of said mask dry plate and secure said mask dry plate via the V-shaped grooves of said clamps.

[Action]

Through the aforementioned configuration, the springs impart energy to the clamps toward the side surface of the mask dry plate to secure the mask dry plate via the V-shaped grooves of the clamps, so the mask dry plate is reliably secured, the portions of the mask dry plate that are hidden by the clamps are made smaller, and it becomes possible to write patterns on nearly the entire surface of the mask dry plate. In addition, the springs push against

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the chrome layer of the side surface of the mask dry plate via the hill portions of the wave-shaped V-shaped grooves of the clamps, so electrical conduction with the mask dry plate is ensured, and accumulation of electrical charges on the mask dry plate is prevented.

[Embodiments]

An embodiment of the present invention will be explained below while referring to drawings.

Figs. 1 (a) and (b) are a plan view and a cross sectional drawing that show the mask holder in an embodiment of the present invention, the same codes have been applied to items that have the same action effects as in the conventional example, and explanations thereof have been omitted. In Figs. 1(a) and (b), a clamp 11 secures the mask dry plate 1 by engaging with the center portion of one of the side surfaces of the mask dry plate 1 by means of wave-shaped V-shaped grooves. In addition, clamps 12 have wave-shaped V-shaped grooves that are able to engage with the other side surface side of the mask dry plate 1. Also, springs 13 impart energy to the side surface of the mask

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dry plate 1 toward the V-shaped groove side of clamp 11 via the V-shaped grooves of clamp 12 to secure the mask dry plate 1 by interposing it between the V-shaped grooves of the clamps 11, 12. In addition, Fig. 2 is an enlarged drawing of the contact portion of a clamp 12 in Fig. 1 and the mask dry plate 1. In Fig. 2, V-shaped groove 12a has a wave-shaped portion 12b dug in a wave shape in clamp 12.

The operation of a mask holder configured in the above way will be explained below. The V-shaped grooves 12a of clamps 12 are pressed against the side surface of the mask dry plate 1 by means of springs 13. The side surfaces of the mask dry plate 1 are interposed between the V-shaped grooves of the clamps 11, 12, and the mask dry plate 1 is secured by the holder 4. At this time, the hill portions that have become the wave shape of the V-shaped groove dug in a V shape ensure electrical conduction between the mask dry plate 1 and the mask holder 4 by means of coming into contact with the edges of the chrome layer 2.

As is clear from looking at Fig. 1(a) and Fig. 5(a), the mask holder resulting from an embodiment of the present

invention does not have upper surface regulating plates 5, so the portions of the mask dry plate 1 that are hidden by the clamps 11, 12 become smaller, and it is possible to write the mask pattern to nearly the entire surface of the mask dry plate 1. Particularly facilitated is the writing of positioning mask patterns for reduction projection apparatuses, in which it is often necessary to write at the edges of the mask dry plate 1.

Figs. 3(a) and (b) show the frequency distribution of the electrical resistance between the mask dry plate 1 and the holder 4 in the case in which the V-shaped grooves of the clamps 11, 12 are made into a wave shape and that in which they are made into a linear shape. Fig. 3(a) is the case of wave-shaped V-shaped grooves, and Fig. 3(b) is the case of linear V-shaped grooves. As is clear from looking at Figs. 3(a) and (b), by making the V-shaped groove into a wave shape, there is more reliable electrical conduction between the mask dry plate 1 and the holder 4.

Fig. 4 is a drawing that shows the area of the portions on which the mask pattern cannot be written on the mask dry

plate 1 due to their being hidden by the clamps 11, 12 or the upper surface regulating plates 5 as well as how far those portions that cannot be written extend from the edges of the mask dry plate 1 in the mask holder resulting from an embodiment of the present invention and a conventional mask holder. As is clear from looking at Fig. 4, compared with the conventional ones, those of the mask holder resulting from an embodiment of the present invention have a large writable area on the mask dry plate 1, and mask pattern writing is possible up to portions near the edges of the mask dry plate 1.

[Effects of the Invention]

In the aforementioned way, through the present invention, it is possible to achieve a superior mask holder which, by pressing clamps that have wave-shaped V-shaped grooves from the side surface of the mask dry plate by means of springs and interposing and securing the mask dry plate between the V-shaped grooves, is, of course, able to reliably secure the mask dry plate, and, since conventional upper surface regulating plates are no longer required,

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enables mask pattern writing on nearly the entire surface of the mask dry plate and ensures electrical conduction with the dry plate.

4. [Brief Explanation of the Drawings]

Figs 1(a) and (b) are a plan view and a cross sectional drawing that show the mask holder in an embodiment of the present invention, Fig. 2 is an enlarged drawing of a clamp of the mask holder resulting from an embodiment of the present invention shown in Fig. 1 and of the mask dry plate portion secured by a clamp, Figs. 3(a) and (b) are frequency distribution drawings of the electrical resistance between the mask dry plate and the mask holder in the case in which the shape of the V-shaped grooves of the clamps are made into a wave shape and that in which they are made into a linear shape in a mask holder of an embodiment of the present invention, Fig. 4 is a drawing that shows the size of the portions on which the mask pattern cannot be written on the mask dry plate as well as the maximum distance from the edges of the mask dry plate of the portions that cannot be written, and Figs. 5(a) and

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(b) are a plan view and a cross sectional drawing that show
a conventional mask holder.

1 Mask dry plate

11, 12 Clamp

12a V-shaped groove

12b Wave-shaped portion

13 Spring

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Fig. 1

1 Mask dry plate

11, 12 Clamp

13 Spring

Fig. 2

12a V-shaped groove

12b Wave-shaped portion

Fig. 3

Frequency (%)

Electrical resistance (K())

Frequency (%)

Electrical resistance (K())

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Fig. 4

Fig. 5

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